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THE NEW SYLLABUS IN ARITHMETIC FOR NEW YORK STATE.

By Charles A. Shaver.

Your president has assigned me the topic "The New Syllabus in Arithmetic for New York State."

In the preparation of a syllabus of this character, it is essential to have, first of all a clear idea of the ends to be attained through the teaching of the subject. The ends or aims in arithmetical study as I understand them are: (1) Performing operations, (2) solution of problems, (3) explanation of processes.

The first of these aims, viz., performing operations, is, in my opinion, the one that should be emphasized in the primary grades, in fact, I hold that it is the only one which the primary teacher should consider.

During the past few years we have had many theories and methods advanced for the teaching of elementary number, many of which have been imperfectly understood and applied and the results have been anything but satisfactory. The Grube method, the ratio method and many others have for a time held a prominent place in primary instruction. We have passed through or nearly through the development stage of number work in which we have entertained the fallacy that no facts should be acquired by children unless the principles and ideas underlying them are first made clear.

Some years ago one of the leading mathematical teachers in the country said that children who spent the first four to six years of their school life in the country succeeded far better in the elementary mathematics than their city-school trained cousins; that as a rule, the country boys and girls who enter our high schools are easily the leaders in algebra and geometry. He attributed these conditions to the fact that country schools are not troubled with much apparatus and that many of the teachers do not keep pace with the latest fads in number; that in these schools interest must be found in the thing itself and that teacher and pupil work together and find it.

That renowned teacher and educational philosopher, Dr. Emerson E. White, is on record as saying, "Were I to be responsible for a child's arithmetical attainments at fourteen, I should insist that his training in number the first three years of school be made as natural and simple as possible and kept largely free from attempted insights into abstract relations and premature efforts at analytical and logical reasoning and I should strongly hope that he might be permitted to reach the third school year unhampered by such logical terminology as *because, whence, hence* and *therefore.* If my pupil at the end of the third school year could add, subtract, multiply and divide simple numbers, I would confidently guarantee his future progress and attainments in arithmetic." And he further says, "Were I to be personally his teacher in grammar grades, I should be delighted to find a few processes, principles and applications out of which the juice had not been sucked in the lower grades."

There is cogent reasoning and sound philosophy in these statements and I think that no apology may be made for a course of study in arithmetic that is in keeping with the ideas therein expressed.

The first of the arithmetical aims mentioned—the performing of operations—is made the aim of the first three years' work in the course of study. To secure, within that time, accuracy and facility in addition, subtraction, multiplication and division, the following principles are advocated:

1. The memorizing of the facts of number.
2. Drill in the use of these facts until facility in operation is secured.
3. The elimination of all use of objects and devices that tend to convey the idea that addition is counting.
4. The elimination of all explanation, *i. e.,* of the reason why —in these fundamental processes.
5. The elimination of fractions and all other applications of number including the solution of problems, that the entire time of the teacher and pupil may be given to securing the aim in view, viz., accuracy and facility in the fundamental operations.

Touching the first of these principles—memorizing the facts of number, it is well known that with the nine significant figures, we may form forty-five combinations in addition, subtraction and multiplication. The syllabus holds that these are to be committed to memory and that sufficient drill and practice be exacted to secure accuracy and facility in their use. The use of objects in this work beyond their simple use in consecutive counting is eschewed, as their use, especially the counting of two groups of objects into a sum instils the idea that addition is counting, which is wrong in principle and fatal in practice, fixing, as it invariably does the pernicious habit of counting the fingers in computation.

The recommendation that the Austrian method of subtraction be used, will, if followed, practically do away with the process of subtraction and greatly reduce the time of teaching the two operations of addition and subtraction.

Referring to the fourth principle enumerated in the foregoing I have to say that it it is the one of all others, which I wish heartily to indorse. Who can compute the wasted time and effort resulting from the futile attempt to teach a child why he carries in addition. This is the time to teach the art of computation, not the science of numbers. I hold that it is impossible to teach a child in the primary grades the science of the Arabic notation, but even if it could be done, it would be no argument for teaching it. What the child *ought* to do, not what he *can* do should here be the guiding principle. As Chancellor Payne says, "To say that we should memorize only what we understand is very much like saying that we should commit nothing to the stomach until it has been digested. We eat to the end that we may digest and we must confide material to the retentive power of the mind in order that the intelligence may find something to work upon."

The second aim in arithmetical study—the solution of problems—is first taken up in the syllabus in the fourth grade. The facts of number and facility in operations acquired in the first three years are now to be applied to the concrete arithmetical problems of life. The syllabus recognizes this as the point where abstract work ends and concrete work begins. To quote from the syllabus for the fourth year, "Simple fractions and equivalents. *Develop objectively.* Simple problems oral and written connected with daily life. Original problem work by the children. Teach cancellation. Have all problems stated before being worked. Use cancellation whenever possible in the solution of these statements."

The adoption of the suggestion to state all problems before working will result in a great saving of time to both teacher and pupil. This compels a pupil to do his thinking first and his work afterwards. It enables a teacher to quadruple the amount of drill in a given time and saves much time in the inspection of work. It also makes cancellation which has heretofore been useless the chief agency in shortening computations.

It follows as a matter of course, that the third aim in arithmetical work—the explanation of processes should, so far as the mental capacity of the pupil to understand, allows, go hand in hand with the solution of problems.

I consider, as worthy of much praise, the emphasis which the syllabus places upon the thorough teaching of the aliquot parts of 100 and their use in decimals and percentage, also the suggested use of the Austrian method in the division of decimals. These suggestions, if adopted, will save much time and contribute to the great twin factors of efficiency in arithmetic—accuracy and facility.

The completion of the ordinary course of arithmetic at the end of the seventh year as required by the syllabus, demands the omission of non-essentials. It may be difficult to secure anything like unanimity of opinion regarding what is and what is not essential in arithmetic. However, in my judgment, the syllabus is to be commended for the omission of the greatest common divisor by the division method, the obsolete tables and work in denominate numbers, its suggestion to emphasize drill and practice with fractions of reasonable magnitude and its advococy of thorough oral and mental training. The omission of the Metric system is likewise, in my judgment, an elimination that has been too long delayed. Why should the grammar school teacher be obliged to teach what nine-tenths of her pupils will never use, and what the few who will have occasion to use, when the high school is reached, can there learn in a few lessons. And learn it there they must, for if studied in the grades, it will, from neglect of use, be forgotten long before the high school is reached.

In concluding I would make special mention of the suggestion made in the last half of the sixth year that the simple equation and the use of the unknown quantity x can be profitably used in the solution of some problems.

Many teachers and many text-book writers seem to think that the equation belongs to algebra, and must be carefully excluded from arithmetic. It is hard to determine how this thought ever gained currency. The elementary treatment of the equation may well begin where recommended in the syllabus and continued through the seventh grade. It is encouraging to know that many of our best arithmetics are preparing for this work. The use of the equation widens the range of problems and simplifies the solution of many. It adds to the power of the pupil and hence to his interest in the subject. It gives a facility in logical reasoning that can not be obtained without its use. It gives to the pupil who never enters the high school the power that comes from the concrete side of algebra. It furnishes the pupil with a convenient tool by means of which he can use and develop his reasoning power. The pupil has the right to an acquaintance with this powerful aid.

In the last analysis, any course of study must be judged by its results. However, if the ends to be attained are based on sound educational philosophy and the means set forth to reach those ends are such as produce power and skill in application, as I believe to be the case with the present course of study in arithmetic, the results can be clearly discerned from the outset.